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and muriatic acids there remained insoluble a small quantity of a brownish colour, which, when fused with carbonate of potash, gave of silica 0.10. The solution, supersaturated with potash, filtered, neutralized, evaporated to dryness, gave of silica 1.450; sum total of silica 1.550.

From these experiments, together with those of Sir Humphrey Davy mentioned above, one might infer that nitrogen is either a compound of silicon and hydrogen, or of silicon, hydrogen, and oxygen; to determine which, synthetically, a current of dry muriatic acid gas was passed over silicuret of potassium (formed by heating silica with potassium), placed in a bent tube of Bohemian glass, the extremity of which dipped into a cup of mercury, lying on the bottom of a vessel filled with water. The atmospheric air had been previously expelled from the apparatus by a current of hydrogen.

The gases insoluble in water having been collected, were found, on examination, to be hydrogen and nitrogen, the relative proportions of which varied in different experiments.

In two experiments the proportions of hydrogen to nitrogen were four of the former to one of the latter.

In a third experiment, as six of hydrogen to one of nitrogen.

In a fourth, as five of hydrogen to four of nitrogen.

*Observation.*—White fumes appeared occasionally in the tube, indicating the presence of muriate of ammonia.

Professor Lloyd exhibited a specimen of Rock from Terre Adele.

Professor Mac Cullagh communicated to the Academy a very simple geometrical rule, which gives the solution of the problem of *total reflexion*, for ordinary media and for uniaxal crystals.

First, let the total reflexion take place at the common surface of two ordinary media, as between glass and air, and let it be proposed to determine the incident and reflected vibrations, when the refracted vibration is known. It is to be observed, that the refracted vibration (which is in general elliptical) cannot be arbitrarily assumed; for, as may be inferred from what has been already stated (Proceedings of the Academy, vol. ii. p. 102), it must be always similar to the section of a certain cylinder, the sides of which are perpendicular to the plane of incidence, and the base of which is an ellipse lying in that plane and having its major axis perpendicular to the reflecting surface, the ratio of the major to the minor axis being that of unity to the constant  $r$ . The value of  $r$ , as determined by the general rule in p. 101, is

$$r = \sqrt{1 - \frac{1}{n^2 \sin^2 i}}$$

where  $i$  is the angle of incidence, and  $n$  the index of refraction out of the rarer into the denser medium. The ellipse is greatest for a particle at the common surface of the media; and for a particle situated in the rarer medium, at the distance  $z$  from that surface, its linear dimensions are proportional to the quantity  $e^{-\frac{2\pi rz}{\lambda}}$ ; so that for a very small value of  $z$  the refracted vibration becomes insensible.

Now, taking any plane section of the aforesaid cylinder to represent the refracted vibration for a particle situated at the common surface of the two media, let  $op$  and  $oq$  be the semiaxes of the section, and let them be drawn, with their proper lengths and directions, from the point of incidence  $o$ ; through which point also let two planes be drawn to represent the incident and reflected waves. Then conceive a plane passing through the semiaxis  $op$ , and intersecting the two wave-planes, to revolve until it comes into the position where the semiaxis makes equal angles with the two intersections; and in this position let the intersections be made the sides of a parallelogram, of which the semiaxis  $op$  is the

diagonal. Let  $OA$  and  $OA'$ , which are of course equal in length, denote these two sides. Make a similar construction for the other semiaxis  $OQ$ , and let  $OB$ ,  $OB'$ , which are also equal, denote the two sides of the corresponding parallelogram. Then will the incident vibration be represented by the ellipse of which  $OA$  and  $OB$  are conjugate semidiameters, and the reflected vibration by the ellipse of which  $OA'$  and  $OB'$  are conjugate semidiameters. And the correspondence of *phase* in describing the three ellipses will be such that the points  $A$ ,  $A'$ ,  $P$  will be simultaneous positions, as also the points  $B$ ,  $B'$ ,  $Q$ .

The same construction precisely will answer for the case of total reflexion at the surface of a uniaxal crystal, which is covered with a fluid of greater refractive power than itself. It is to be applied successively to the ordinary and extraordinary refracted vibrations, and we thus get the *uniradial* incident and reflected vibrations, or rather the ellipses which are similar to them. And as any incident vibration may be resolved into two which shall be similar to the uniradial ones, we can find the reflected vibration which corresponds to it, by compounding the uniradial reflected vibrations.

It may be well to mention that, in a uniaxal crystal, the plane of the extraordinary refracted vibration is always perpendicular to the axis, and therefore the ellipse in which the vibration is performed may be easily determined by the remark in p. 102. The plane of the ordinary vibration has no fixed position in the crystal; but if we conceive the auxiliary quantities  $\xi_1$ ,  $\eta_1$ ,  $\zeta_1$ , (p. 98) to be compounded into an ellipse (as if they were displacements), the plane of this auxiliary ellipse will be perpendicular to the axis of the crystal.

Whether the preceding very simple construction, for finding the incident and reflected vibrations by means of the refracted vibration, extends also to the case of *biaxal* crystals, is a point which has not yet been determined, on account of the complicated operations to which the investigation leads, at least when attempted in any way that obviously suggests itself.

Joseph Huband Smith, Esq. was elected a Member of the Committee of Antiquities, and Dr. Aquilla Smith was elected Treasurer of the Academy, in the room of Dr. Orpen, resigned.

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The following Address was presented on the 13th November to the Lord Lieutenant :

*“ To His Excellency the Right Hon. Thomas Philip Earl De Grey, Lord Lieutenant-General and General-Governor of Ireland.*

“ MAY IT PLEASE YOUR EXCELLENCY,

“ We, the President and Members of the Royal Irish Academy, have the honour to present to your Excellency our very sincere congratulations on your arrival in our metropolitan city, as the representative of our most gracious Sovereign.

“ It has been the pleasure of her Majesty to declare herself the Patron of the Institution of which we are members ; and, in virtue of the charter which was granted to us by one of her royal predecessors, King George the III., the office of Visitor of the Academy has become vested in your Excellency, as Lord Lieutenant of Ireland.

“ We cannot but think ourselves fortunate in an official connexion with a nobleman who, in his private career, has shown himself so much attached to arts and letters as your Excellency is known to be.

“ The objects of the Royal Irish Academy are Science, Polite Literature, and Antiquities ; and in the tranquil pursuit of these objects, the importance of which is appreciated by your Excellency, we have had the pleasure of seeing fostered within our body those feelings of mutual good-will, which are, perhaps, scarcely less highly to be prized than the pursuit of knowledge itself.

(Signed)

“ WILLIAM ROWAN HAMILTON, President.”